from the glacial sea, its present contour was more prominently determined, and it has been subsequently further modified and enlarged by the older river and its tributaries. There is even some reason for believing that its present outflow was not its former one, but that, acording to Mr. S. V. Wood, jun. (whose researches are so well known) the river probably drained southward into the Weald, being barred in by a ridge of lofty land *now* cut through by the Thames river.

The deposits of the ancient river afford memorials of considerable interest, for they tell us that along its forest-clad margins lived numerous mammalia, most of which have become extinct in the British area, although some of the genera are now restricted to the Europeo-Asiatic continent. Thus we find remains of the rhinoceros, elephant, hippopotamus, bear, and lion entombed in the valley deposits, affording a proof that at that period or previously England was joined to the Continent, over which land these animals probably migrated, so that the insular position of England is but of comparatively modern date. A further study of these remains yields to us the important evidence that in this area there were representatives of a northern and southern fauna,—the commingling of which, as the reindeer and musk ox with the hippopotamus and rhinoceros, may have arisen from the Thames area having been on the borders of two distinct zoological provinces. While, however, the majority of the Mammalia belong to extinct species, the Mollusca with which they are associated are, with two or three exceptions, still found in Britain; one shell, however, the *Cyrena fluminalis*, is at present restricted to the Nile; this assemblage in the old brick-earth deposits of the Thames valley indicating a greater tenacity of life in the molluscan than in the mammalian fauna.

WEINHOLD'S EXPERIMENTAL PHYSICS

Vorschule der Experimentalphysik. Von Adolf F. Weinhold, Professor an der Königl. höheren Gewerbschule zu Chemnitz. Erster Theil. (Leipzig, 1871. London: Williams and Norgate. Pp. 208.)

THIS is by far the best school-book of Physics we have ever seen. Its leading characteristic will be understood by many readers from the statement that it is intended to be for Physics what Stöckhardt's well-known "Vorschule der Chemie" is for Chemistry. The author endeavours, as far as possible, to bring the reader into personal contact with physical experiments and phenomena. He does this by describing in detail, not only how to produce the phenomena and make the experiments of which he speaks, but also, in most cases, how to make the necessary apparatus with such materials as are to be got in almost any country-town. The result is that we cannot imagine a boy who possesses, in any degree, what is called a "mechanical turn" reading this book, without wanting to set to work at once to make experiments for himself. One of the main objects of the book is, in fact, to give a definite and useful direction to the "taste for making all sorts of things," which, as the author says, is so common amongst boys. With this intention he has made a careful choice of such experiments as, "by their pleasing nature, are adapted to awaken an interest in physical studies, but has avoided, as far as possible, the introduction of mere playthings, and has altogether excluded everything like conjuring tricks." With regard to the expenditure required for making the experiments described, the author estimates it at about fifty thalers (7*l.* 10*s.*) or a little more, but points out to those who are unwilling or unable to incur the gradual outlay of this sum, how much may be done for far less. A hammer and pair of pliers, "a small vice, a hand-vice, a few files, some sheet brass and wire, a spirit-lamp, a stock of glass tubing, and one or two retort-stands, suffice for a great deal, and should be provided before everything else."

We are glad to think that there are nowadays in this country a considerable and increasing number of schoolmasters who are anxious to introduce Experimental Physics as a regular part of school work, but who are deterred partly by the expense of the apparatus commonly thought necessary, and partly from the want of clear and full instructions as to how it should be used when they have got it. To any such we can do no greater service than to recommend them immediately to obtain Prof. Weinhold's book, and to follow implicitly the directions he gives.

We must not, however, leave it to be supposed that this work is simply a collection of practical instructions for making apparatus and experiments. Although each subject, even in the part now before us (which includes the general properties of bodies, statics, dynamics, hydrostatics, and hydrodynamics) is discussed from the point of view afforded by the particular experiments which it is intended that the reader should make for himself, the general conclusions to which the results of these experiments lead are always clearly and carefully pointed out; and a student who would work patiently through the book would lay a broad and sound foundation for a more special study of Physics, and would certainly know far more of the subject than the majority of those who have gone through in the ordinary way books of much greater pretensions. Above all, he could not fail to acquire one indispensable qualification for further progress, namely, the faculty of thinking about physical phenomena as of things which actually exist, and are just as fit subjects for the exercise of common sense as any of the facts of everyday life. This we consider is in itself no small excellence; for whoever has had any experience in teaching the elementary parts of Physics, must have become aware that very often the chief result of the *à priori* method, adopted in nearly all English books on the subject, is to make students think that the forces and motions of which Natural Philosophers talk are, if not fictions invented on purpose to puzzle them, at least so unlike anything that is ever met with in common experience, that it is useless to try to understand anything about them. In fact we believe that, except for students whose previous training has accustomed them to recognise the special cases that are included under general mathematical expression, the majority of English treatises on the fundamental parts of Physics are rather a hindrance than a help to a clear conception of the ideas they profess to explain. The true method of teaching Physics, at least to beginners, we believe to be the one adopted in this book, whereby the learner is made to acquire an actual personal acquaintance with all the most important facts of the science, through the observations which establish them having been brought within the range of his personal experience.

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If this is done at all thoroughly, the modes of expressing the laws of physical phenomena in technical mathematical language may almost be left to suggest themselves when the requisite progress shall have been made in pure mathematics.

BOOK SHELF

The Sub-tropical Garden; or Beauty of Form in the Flower-Garden. By W. Robinson, F.L.S. With Illustrations. (London: Murray, 1871.)

THIS volume is a sequel to the valuable works which Mr. Robinson has already given us—"The Wild Garden," and "Alpine Flowers for English Gardens." The title is a misleading one, and, is thus defined by the author:—"Sub-tropical gardening means the culture of plants with large and graceful or remarkable foliage or habit, and the association of them with the usually low-growing and brilliant flowering-plants now so common in our gardens, and which frequently eradicate every trace of beauty of form therein, making the flower-garden a thing of large masses of colour only." It is a pity that Mr. Robinson has assisted to perpetuate so erroneous a designation, which conveys the idea of the culture of tender plants fitted only for our hothouses. The greater part of the volume is occupied with an alphabetical list of plants suitable for the above purpose, with description of the peculiarities of their foliage, mode of cultivation, and propagation, &c. The accompanying cut is intended to suggest the effects to be obtained from young and vigorous specimens of hardy, fine-leaved trees. In all these points Mr. Robinson may be safely followed as a guide, combining great practical knowledge of gardening, an extensive acquaintance with the native habits of plants, and an artist's eye to the beauty of form and combination. The following sentence gives his idea of what gardening should be. "Nature, *in puris naturalibus*, we cannot have in our gardens, but Nature's laws should not be violated; and few human beings have contravened them more than our flower-gardeners during the past twenty years. We should compose them from Nature, as landscape artists do. We may have in our gardens, and without making wildernesses of them either, all the shade, the relief, the grace, the beauty, and nearly all the irregularity of Nature." A. W. B.

AILANTUS AND CANNAS

The Meteoric Theory of Saturn's Rings, considered with Reference to the Solar Motion in Space; also a paper on the Meteoric Theory of the Sun. By Lieut. A. M. Davies, F.R.A.S. (London: Longmans & Co.)

PROF. CLERK MAXWELL, in his remarkable essay "On the Stability of Saturn's Rings," which gained the Adams Prize in 1856, exhaustively examines the various theories of the constitution of these rings, and decides what are the impossible mechanical conditions for their maintenance and what is the possible one. He shows that they cannot be solid or rigid; he disposes of the possibility of their being continuously fluid, and he concludes that "the only system of rings which can exist is one composed of an indefinite number of unconnected particles revolving round the planets with different velocities according to their respective distances." Lieut. Davies appears not to have seen Prof. Maxwell's work, as he ascribes to the perusal of a derived exposition of it the enlistment of his interest in favour of the Satellite theory of the rings. Having espoused this theory, he has sought an explanation of Saturn's possession of a ring system in the supposition that the planet has picked up streams of meteors in its path through space; this path being a spiral resulting from the planet's orbital motion in conjunction with the proper motion of the solar system. The spirals traversed by the four planets beyond Mars are projected in accordance with Lieut. Davies's assumption of the solar motion, in order to show that Saturn is (excepting Jupiter) more favourably circumstanced than other planets for encountering wandering streams of meteors that are drawn towards the sun; while, from consideration of the masses and the distances of the two planets from the sun, it is argued that Saturn is better circumstanced than Jupiter for attaching such streams permanently to his system in the form of rings. The details of Lieut. Davies's work can only interest those who are closely concerned with cosmical hypotheses. We will merely remark that he appears to place too great faith in figures: he gives the hourly rate of the solar motion in space to a mile, and quotes the solar parallax to four places of decimals! The velocity is a very uncertain element of the solar motion, and a small alteration of the rate assumed by Lieut. Davies would greatly modify his conclusions. The book includes a paper on the meteoric theory of the sun, a theory with which the author is blindly enraptured. He claims that it "accounts for every phenomenon hitherto observed on the solar surface." He holds that the "willow leaves" are meteoric flights just falling into the sun; that the spots are spaces upon which no meteors are raining; that the periodicity of spots is due to the action of the planets in pulling "the meteoric matter outwards from the surface of the sun into larger orbits, thus temporarily delaying its precipitation," and that "the form of the spots bespeaks their origin as extraneous to the solar machinery. Were they cyclones in the atmosphere, they would invariably present a rotatory appearance . . . . This must result were the origin of the spots in a plane parallel to the tangential plane at the sun's surface; but would not do so if their origin lay in the normal to that plane, as it does in the meteoric theory. A careful study of Mr. Carrington's valuable series of observations of solar spots is decidedly unfavourable to the conclusion that they have forms of rotation." Lieut. Davies is either innocently or wilfully ignorant of the palpably cyclonic appearance which spots frequently present, and which has been frequently depicted by observers who have studied the characteristic features of individual spots. This study did not concern Mr. Carrington. The devotees of the meteoric theory of the sun's maintenance will not feel that it has been much advanced by Lieut. Davies's over-straining advocacy.

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